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Title of the Theme Lecture
Physical Modelling of Dynamic Soil-Foundation-Structure Interaction

Abstract
The phenomenon of dynamic soil-structure interaction has been studied for more than two decades. While the early engineering practice has largely considered that the soil-structure interaction has beneficial effects and will lead to larger than expected factor of safety, it is now recognised that such interaction can also be detrimental under certain circumstances. It is therefore important to investigate and understand the SSI effects carefully. In addition to this the effect of one structure on a neighbouring structure through the intervening soil has opened up a relatively new field of structure-soil-structure interaction (SSI). In geotechnical earthquake engineering the investigation of SSI and SSSI effects needs high quality data so that reliable analytical or numerical modelling can be attempted. Dynamic centrifuge modelling offers an excellent opportunity to study such effects.

In this theme lecture, the recent advances in physical modelling of dynamic soil structure interaction effects will be emphasised. The high gravity experimental facilities developed at the Schofield Centre, University of Cambridge including the Servo-Hydraulic earthquake actuator and specialist model containers will be introduced. The use of these facilities in studying SSI and SSSI problems will be highlighted using the following examples. Firstly the use of Tuned Mass Dampers (TMD) in structures will be studied. It will be shown that use of TMD’s without due consideration for the soil-structure interaction can lead to adverse effects in the structural response from the TMD’s. Further it will also be shown that the use of TMD’s in one structure can lead to adverse structural response in the adjacent structure due to SSSI effects. Next, an investigation of rocking of a MDOF structure will be presented. Results from two identical structures in which foundation rocking and structural rocking are encouraged, will be compared. Thirdly, the use of viscous dampers in structures will be investigated using the dynamic centrifuge modelling. The efficacy of the viscous dampers with and without the soil-structure interaction effects will be studied. Finally the case of foundation-soil interaction will be investigated using single pile and pile groups that are embedded in soft clay. The inertial and kinematic interactions and the role these play in the overall performance of the pile foundation will be discussed.

Bio
Dr Gopal Madabhushi is a Professor of Civil Engineering at the University of Cambridge, UK and the Director of the Schofield Centre. He is also the Head of the Geotechnical and Geo-Environmental Group at Cambridge. He has over 25 years of experience in the area of Soil Dynamics and Earthquake Engineering. His expertise extends from dynamic centrifuge modelling to the time domain finite element analyses of earthquake engineering problems. He has an active interest in the areas of soil liquefaction, soil-structure interaction and liquefaction resistant measures and their performances. He has an active interest in the biomechanics of hip replacement surgeries. He has acted as an expert consultant to the industry on many geotechnical and earthquake engineering problems e.g. Mott MacDonald, Royal Haskong and Ramboll-Whitby, UK. He has an active interest in post-earthquake reconnaissance work and has led engineering teams from UK to 921 Ji-Ji earthquake of 1999 in Taiwan, the Bhuj earthquake of 2001 in India and many other missions. He served as the Chairman of Earthquake Engineering Field Investigation Team (EEFIT) that runs under the auspicious of Institute of Structural Engineers, London. He served on the BGA Executive Committee from 2014-16. He was awarded the TK Hsieh award in 2005, 2010 and 2013 by the Institution of Civil Engineers, UK, the BGA medal in 2010 given by British Geotechnical Association, the Shamsher Prakash Research Award in 2006, Medical Innovations Award in 2007 the IGS-AIMIL Biennial award in 2008 and the Bill Curtin Medal in October 2009 by the Institution of Civil Engineers, UK, IGS-ONGC Biennial Award in 2013, IGS-Prof Shamsher Prakash Biennial Award in 2016 for his contributions in the area of Soil Dynamics, Tsunami’s and Earthquake Engineering. He has 150+ Journal Publications and 275+ papers in International conferences and workshops to date. He has authored a very successful book on the Design of Pile Foundations in Liquefiable Soils (Imperial College Press) and Geotechnical Chapters in the book on Designing to Eurocode 8, 2nd Edition (Taylor & Francis). His book on Centrifuge Modelling for Civil Engineers was published by Spon Press/Taylor and Francis publishing group.